ORDER

6160.11

SYSTEM IMPLEMENTATION PLAN
ENHANCED DIRECT ACCESS RADAR CHANNEL

August 12, 1985

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

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Initiated By: APM-210

RECORD OF CHANGES

DIRECTIVE NO. 6160.11

CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL USE	CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL USE

FAA Form 1320-5 (5-68) SUPERSEDES PREVIOUS EDITION

GPO : 1968 OF—308-383

This order sets forth the System Implementation Plan (SIP) for enhanced direct access radar channel (DARC). It provides management direction for the establishment of enhanced DARC, a system which provides for (1) the expansion of the basic DARC control processor (CP) and display processor (DP), (2) increased memory and computing capacity, (3) additional tape drives, and (4) individual sector switching between primary channel National Airspace System (NAS) en route computers and DARC. In addition, this plan provides for the implementation of several new software features. With this new software (1) predicted-position tracking of mosaicked radar data will be possible, (2) sector jurisdictional track control with nonverbal hand-off capability will be available, and (3) a system analysis recording to support event re-creation will also be possible. Also, in the event of radar data processing (RDP) failure, the new software will allow automatic transition from the DARC backup mode, DARC/NAS, to a DARC-with-NAS flight data processing (FDP) mode called DARC/FDP. If this FDP mode were to fail, automatic transition from a DARC/NAS or DARC/FDP mode to a DARC only mode, DARC, would also be possible.

for Thomas J. Brew

Martin T. Pozesky
Director, Program Engineering
and Maintenance Service

LIST OF FIGURES

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1. PURPOSE. This order transmits the enhanced DARC System Implementation Plan (SIP) for execution.

2. DISTRIBUTION. This order is distributed to the division level within the Program Engineering and Maintenance (APM), Systems Engineering (AES), Acquisition and Materiel (ALG), Air Traffic Operations (ATO), and Air Traffic Plans and Requirements (ATR) Services at the Washington headquarters; to the division level at the FAA Technical Center, to the division level at the Mike Monroney Aeronautical Center, to the regional Air Traffic and Airway Facilities divisions, and to Air Traffic and Airway Facilities offices at the Air Route Traffic Control Centers (ARTCCs).

3. BACKGROUND. The direct access radar channel (DARC) enhancement program will expand the capabilities of the DARC system by augmenting the existing software and hardware features. The DARC enhancement will be installed at the 20 Federal Aviation Administration (FAA) air route traffic control centers (ARTCCs) in the continental United States, the FAA Technical Center and the FAA Academy. The DARC enhancement program for the first three sites and site 5, i.e., the FAA Technical Center, the FAA Academy, and the pilot sites (Cleveland and Boston ARTCC's) includes acquisition, production, factory testing, facility preparation, installation, onsite testing, training, maintenance concepts and procedures, and logistics. For sites no. 4 and no. 6 through no. 22, the DARC enhancement program will include production, factory testing, and delivery to the Government at the contractor's facility, with site installation and testing to be performed by the FAA. This implementation plan provides the details and schedules essential to the successful completion of the program.

4. REQUEST FOR INFORMATION. The program manager for this order is the Manager, En Route Automation Program, APM-210. Any requests, suggestions, or comments should be directed to that office.

5. RESERVED.

CHAPTER 2. PROGRAM MANAGEMENT

6. INTRODUCTION. The overall technical management of the DARC Enhancement Program is the responsibility of the Air Traffic Control Automation Division, APM-200, and in particular, the En Route Automation Program, APM-210. This organization will accomplish the management task within the guidelines provided by agency policies, procedures, and directives. A member of this program is designated DARC Enhancement Program Manager and is the single focal point for all program activities.

7. CONTRACT MANAGEMENT.

a. A contracting officer (CO), designated in ALG-320, performs the general contract management activities of the monitoring of contractor schedules, problem reports and solutions, meeting attendance, inspections, in-progress review conduct, and all other activities concerned with assuring that the terms of performance under the contract are met. The CO is the only person authorized to make changes that will affect prices, deliverables, or schedules.

b. A quality/reliability officer (QRO), designated in ALG-400, is the FAA's representative at the contractor's facility. The QRO's functions are governed by FAA policies and procedures, and by the terms and conditions of the contract.

c. A technical officer (TO), designated in APM-210, provides technical guidance and direction to the contractor within the scope of the contract. The TO assures that the contractor has access to technical documentation, appropriate data bases, and sources of information relative to government furnished equipment (GFE). The TO does not have the authority to make any changes in the provisions of the contract or the requirements of the specification.

8. REGIONAL PROGRAM MANAGEMENT.

a. Each regional Airway Facilities division has appointed a DARC program manager. The names of these program manager are listed in table 2-1. The regional program manager shall assure that facilities and engineering work is complete at each of the region's ARTCCs prior to delivery of the DARC EEM material to the ARTCCs. He will then monitor the installation of the DARC modification, coordinating requests for contractual or technical support with APM-210 or the National Automation Engineering Field Support Sector, APM-160. The regional program manager has arranged for the appointment of a technical representative (TR) at each of the region's ARTCCs. Their names are listed in table 2-1. The duties of the TR will be explained in paragraph 9 below. It is suggested that prior to the start of the modification at his facility, the TR should visit a site, which is installing the modification, to obtain ideas as to how best accomplish the modification.

Table 2-1
DARC Enhancement Program Managers and Facility Technical Representatives

SITE	SITE TECHNICAL REPRESENTATIVE	DARC PROGRAM MANAGER
FAA Technical Center	Hugh Cole, ACT-614A, FTS 482-6196	Tom Hahn, APM-161, FTS 482-4231
FAA Academy	Ken Lynch, AAC-52C, FTS 749-2721	Bob Quinn, AAC-942B, FTS 749-4161
Cleveland	Bob Ontolchek, AFS, FTS 292-8267	Al Falkenstein, AGL-435.1, FTS 384-7452
Washington, DC	Dave Latanzio, AFS, FTS 925-4331	Pete Scotti, AEA-462, FTS 667-1287
Boston	Vic Beauregard, AFS, FTS 834-6171 (page)	Bill Tretter, ANE-420, FTS 836-1281
Salt Lake	Gordon Houston, AFS, FTS 586-3255	Ernie Shorb, ANW-455, FTS 446-2439
New York	Bob Roessler, AFS, FTS 663-3510, 3578	Pete Scotti, AEA-462, FTS 667-1287
Minneapolis	Bob Otts, AFS, FTS 784-3211	Al Falkenstein, AGL-435.1, FTS 384-7452
Atlanta	Billy Bolton, AFS, FTS 249-3754	William Kimber, ASO-432, FTS 246-7638
Fort Worth	David Rye, AFS, FTS 334-1251	James Flener, ASW-432, , FTS 734-2658
Oakland	Bill Reed, AFS, FTS 449-6361	Joe Metcalfe, AWP-422.2, FTS 966-6421
Indianapolis	Darrell Hornbeck, AFS, FTS 332-0205	Al Falkenstein, AGL-435.1, FTS 384-7452
Denver	Francis McKinney, AFS, FTS 323-4433	Ernie Shorb, ANW-455, FTS 446-2439
Jacksonville	John Givens, AFS, FTS 946-2876 x460	William Kimber, ASO-432, FTS 246-7638
Chicago	Bill Frazeur, AFS, FTS 388-9261	Al Falkenstein, AGL-435.1, FTS 384-7452
Memphis	Edward Powell, AFS, FTS 365-0970	William Kimber, ASO-432, 246-7638
Seattle	Jim Dubey, AFS, FTS 390-5311	Ernie Shorb, ANW-455, FTS 446-2439
Albuquerque	Jack Elston, AFS, FTS 476-0282	James Flener, ASW-432, FTS 734-2658
Los Angeles	Ralph Dunham, AFS, FTS 799-1256	Joe Metcalfe, AWP-422.2, FTS 966-6421
Kansas City	Ralph Orr, AFS, FTS 753-1346	Phil Duffy, ACE-454.4, FTS 758-7124
Houston	Lonnie Angst, AFS, FTS 521-3070	James Flener, ASW-432, FTS 734-2658
Miami	Ray Hoffman, AFS, FTS 350-2678	William Kimber, ASO-432, FTS 246-7638

b. Although the installation of the DARC modification will initially not affect air traffic control procedures, subsequent deliveries of DARC and 9020 software will have significant impact on the present procedures used in going to and coming from DARC operation. The regional Air Traffic divisions will be responsible for assuring that the new DARC-related procedure changes are implemented as directed by the Air Traffic Operations Service.

9. ARTCC PROGRAM MANAGEMENT.

a. The TR shall be responsible for assuring that the DARC facilities and equipment site preparation activities are complete and acceptable before the start of the DARC enhancement modification. During the actual installation of the enhancement modification equipment, the TR shall be responsible for (1) the coordination of the necessary DARC and primary channel downtime, (2) the scheduling of the necessary personnel to install the DARC modifications, (3) the reporting of problems encountered in the installation, and (4) the resolution of these problems (with the help of the region, FAA Depot, APM-160, and APM 210, if required).

b. The duties of the TR will be complete after the DARC hardware EEMs have been installed, the testing outlined in the EEMs has been completed, and a JAI has been conducted on the facilities and equipment work done at the site. Subsequent software deliveries from APM-160 (which will initiate some or all of these enhanced features) shall be handled in the same manner as the present DARC software deliveries.

10. CONFIGURATION MANAGEMENT.

a. The contractor has a configuration management program in accordance with FAA Order 1800.8D to ensure positive control of the enhanced DARC system throughout the life of the contract. This program provided for the orderly development and documentation of a detailed definition of the hardware and software configuration during the design and development phases of the system upgrade. As a result, an accurate system definition was available at the completion of all engineering evaluation tests and acceptance of the DARC system enhancement design by the Government.

b. Configuration control of the enhanced DARC system was exercised by APM-210 until the successful completion of the system level tests on the first system (FAA Technical Center). After these tests were completed, the enhanced DARC system was baselined and put under formal agency configuration management in accordance with FAA Order 1800.8D.

11. NATIONAL AUTOMATION ENGINEERING FIELD SUPPORT SECTOR (APM-160).

a. APM-160 is responsible for monitoring the contractor in-plant testing of the enhancement hardware and software. APM-160 personnel coordinated the modification of FAA Technical Center equipment by contractor personnel and verified the step-by-step procedures of the contractor-written enhancement modifications. In addition, APM-160 monitored the installation of the FAA Academy. The Academy installation served as the system test of the modifications.

b. APM-160 concurred with the contractor modification procedures prior to the commencement of the key site installation at Cleveland ARTCC. APM-160 then again monitored the enhancement modification installation at Cleveland.

c. Upon successful installation of the hardware modifications at Cleveland ARTCC, APM-160 issued the DARC enhancement installation EEMs to the field. (The FAA Technical Center and FAA Academy were installed using draft EEM's.) APM-160, in cooperation with APM-210 and the contractor, shall arrange for the delivery of the modification installation kits to each ARTCC, and shall, in cooperation with the regional AF divisions, direct each site as to when it should begin the modifications.

12.-15. RESERVED.

16. GENERAL. The DARC system was designed to backup the radar data processing performed in the primary channel. The contract for the Basic DARC system was awarded in September 1976, and the last system was commissioned for operational use in June 1981. In April 1982, a contract for an enhanced DARC system was awarded as a result of field experiences and new requirements. These two systems are discussed in the following sections.

17. BASIC DARC.

a. In operating as a backup system, basic DARC was to replace the current broadband system. The capabilities necessary to perform this function are listed below:

(1) Accept and process 700 radar messages per second from up to 15 radar sites.

(2) Accept and process 500 R-controller messages per minute.

(3) Provide a narrowband display of beacon, search and weather data.

(4) Display geographical maps.

(5) Provide Mode C correction and altitude filtering.

(6) Display and refresh for 60 Plan View Displays (PVDs).

(7) Provide automatic fault detection and reconfiguration.

(8) Interface with the primary channel for associating beacon codes with flight identifiers.

(9) Interface with the weather message switching center for current altimeter information.

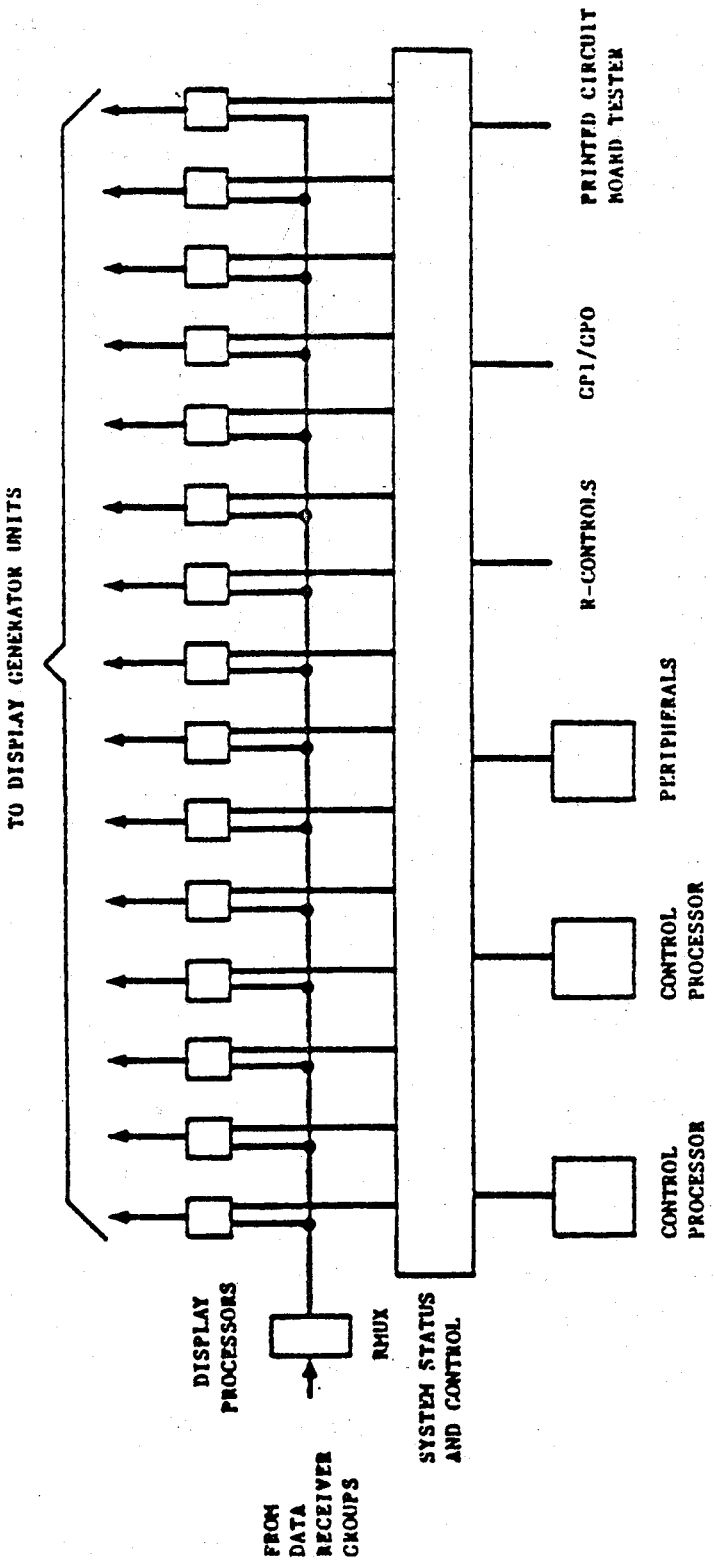
b. A block diagram of the distributed processor DARC system is shown in figure 3-1. A pictorial of the DARC system is at figure 3-2. The major components are the RADAR multiplexer (RMUX), display processor (DP), control processor (CP), system status and control (SSC), and peripherals. The major characteristics of each component are listed below:

(1) Radar Multiplexer.

(a) Accepts data from 15 radars.

(b) Accepts 3 channels per radar at a rate of 2400 bps.

Figure 3-1
DARC System Configuration



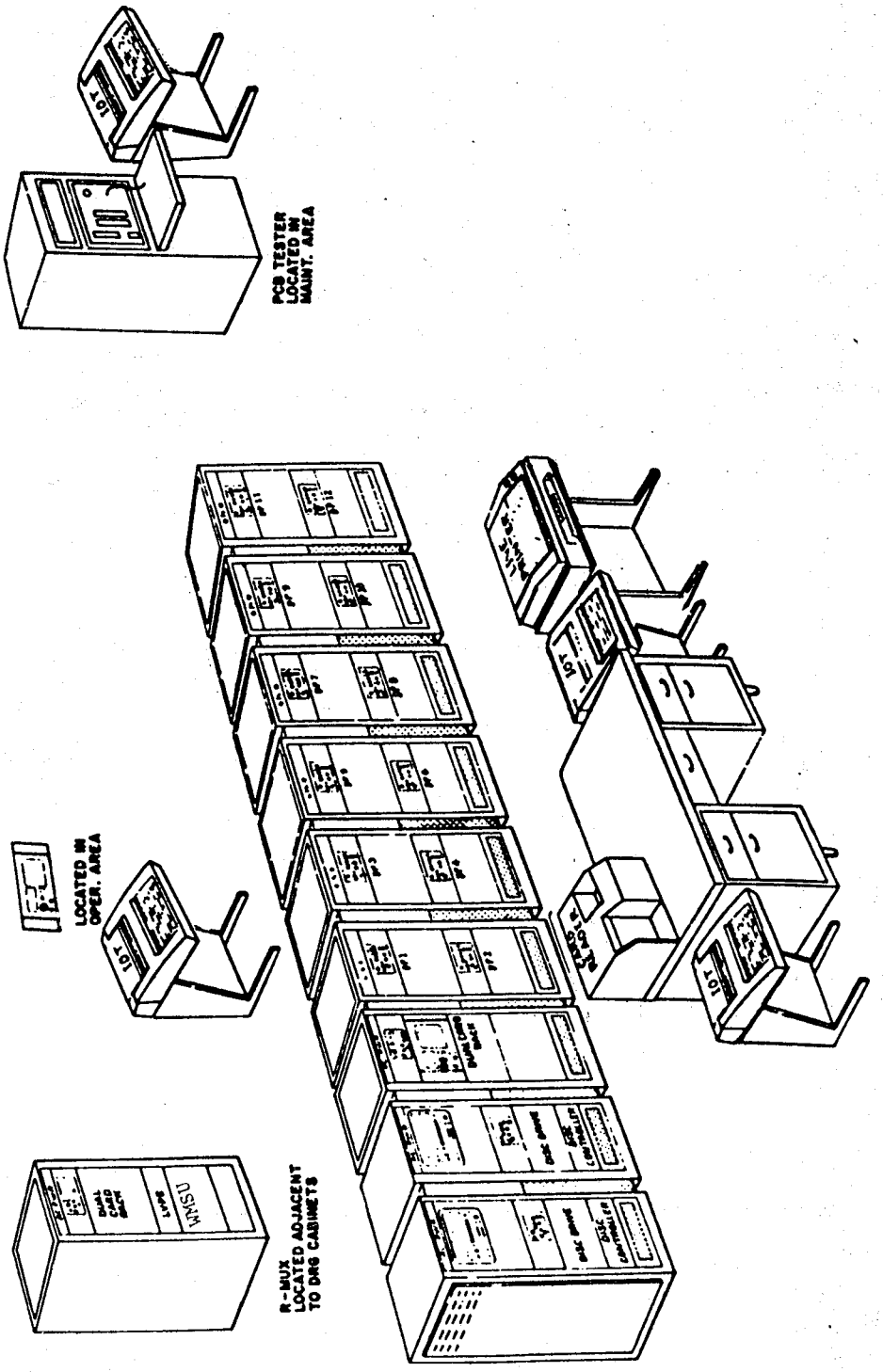


Figure 3-2
Basic DARC

(c) Provides multiplexed output on a 1 MHz redundant bus distributed to all DPS.

(2) Display Processor (DP).

(a) RDS-500 Minicomputer - 64K core memory.

(b) Performs coordinate conversion and geographical filtering of radar data.

(c) Perform altitude and discrete beacon code filtering.

(d) Provides limited and full data blocks.

(e) Provides refresh for 6 PVDs.

(f) Performs status monitoring and reporting.

(3) Control Processor (CP).

(a) RDS-500 minicomputer - 64K core memory.

(b) Obtains program adaptation and map data from disk.

(c) Transmits above data to DPs.

(d) Obtains and distributes R-controls data.

(e) Performs system monitoring and reconfiguration.

(f) Communicates with primary channel and peripherals.

(4) System Status and Control.

(a) Provides data path from the online CP to the online DPs and peripherals.

(b) Provides hardware interfaces to the primary channel and peripherals.

(c) Contains timing circuitry and interface to the R-controls.

(d) Provides a data path from the online CP to the standby CP.

(e) Connects CP-2 to the printed circuit board tester.

(5) Peripherals.

(a) 1 cartridge disk per CP - 1.3 million words of storage.

(b) 1 line printer.

(c) 3 I/O typewriters.

(d) 1 card reader.

(e) Weather Message Switching Unit (WMSU).

c. The basic DARC system is installed and commissioned at twenty ARTCCs.

18. ENHANCED DARC.

a. In the enhanced DARC system, tracks will be automatically initiated using flight plan related data received from the 9020 via a communications interface between the 9020 and DARC. If the 9020 becomes non-operational, enhanced DARC will continue to track and display full data blocks. When the 9020 again becomes available, necessary track data will be transmitted to the 9020 from the enhanced DARC to aid in bringing the 9020 back online. This enhanced DARC capability will be provided by the addition of a 16 bit microcomputer and associated memory to RDS-500 minicomputer used in basic DARC. Also, the memory of the RDS-500 will be doubled by using semiconductor instead of core memories. High Order "C" language will be used in programming the new 16 bit computer. In addition, the Enhanced DARC will have provisions for switching individual plan view displays (PVDs) between DARC and the 9020. Two tape recorders and a data simulator are also added to each system. A pictorial of the DARC enhancements is at figure 3-3. Although the enhanced system will still only be a backup system, it will provide most of the radar data processing capabilities of the primary channel. These capabilities include:

(1) Multiple radar processing - mosaicking.

(2) Stereographic projection.

(3) Altitude and slant range correction.

(4) Tracking of beacon and search aircraft.

(5) Automatic initiation of tracks on aircraft with discrete beacon codes.

(6) Automatic entry of barometric pressure data.

(7) Handoff and jurisdictional control of tracked aircraft.

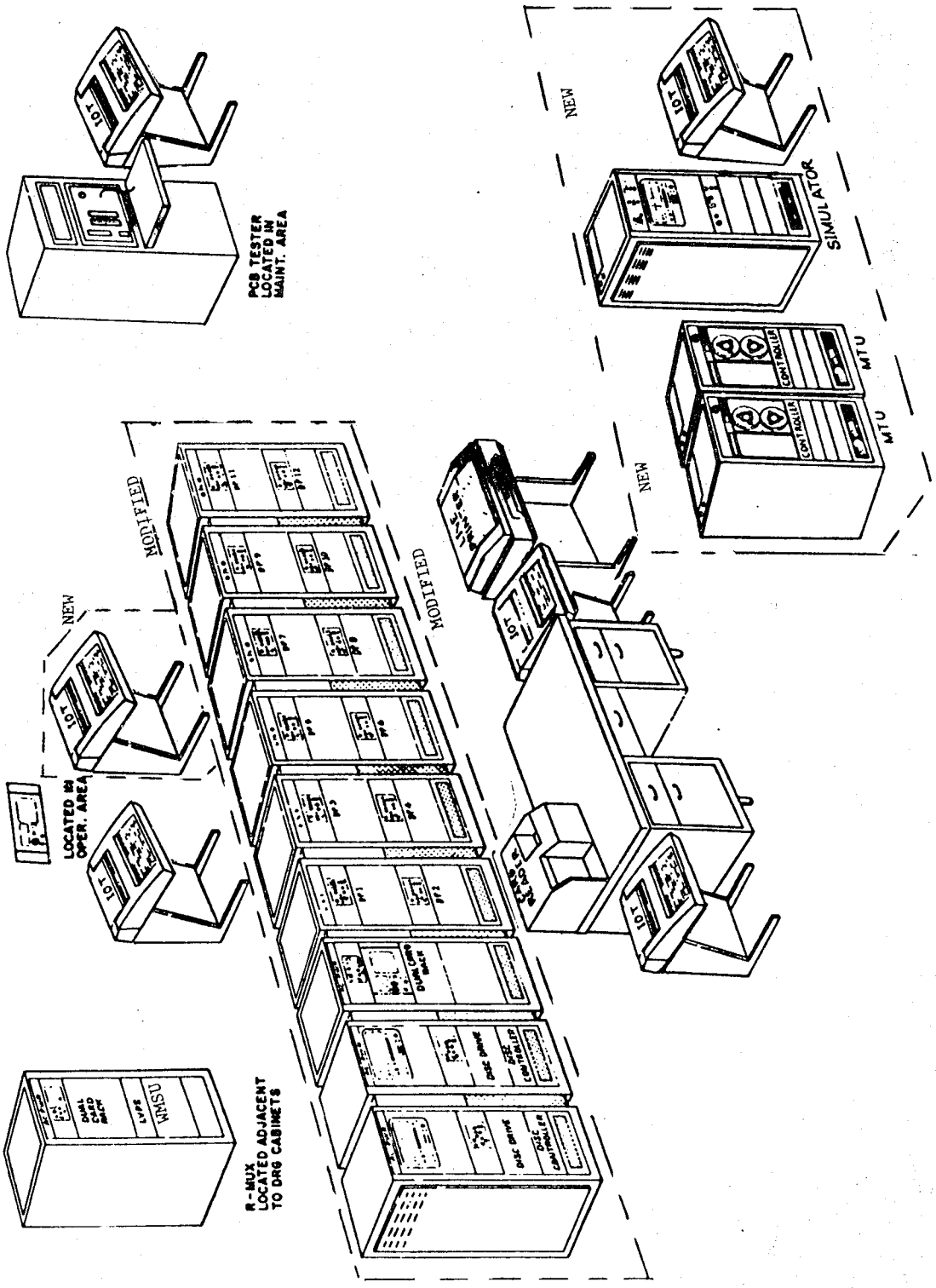


Figure 3-3
DARC With Enhancement

(8) Automatic assignment of discrete beacon codes.

(9) Real time quality control of radar performance.

(10) Online recording of system analysis data.

(11) Bidirectional interface with the primary channel.

(12) Individual PVD switching.

(13) Data recording for post-incident analysis.

(14) Automatic reconfiguration of DCVGs.

b. The hardware characteristics of the CP and DP are as follows:

(1) CP. RDS-500 minicomputer with 128K semiconductor memory, supplementary 16-bit microprocessor with 128K semiconductor memory and 16K of programmable read only memory (PROM), 32 asynchronous duplex communications channels, and disk controller.

(2) DP. RDS-500 minicomputer with 128K semiconductor memory, supplementary 16-bit microprocessor with 128K semiconductor memory and 16K of programmable read only memory (PROM), refresh output control, and Input Data Selector controlled by a 16-bit microprocessor.

c. Estimates of memory and processor utilization include:

CP	TOTAL MEMORY AVAILABLE	EST. UTILIZATION%
CP RDS-500	128K	50%
CP SUPPLEMENTARY PROCESSOR BOARD	128K	62%

DP	TOTAL MEMORY AVAILABLE	EST. UTILIZATION%
DP RDS-500	128K	44%
DP SUPPLEMENTARY PROCESSOR BOARD	128K	29%
DP MODIFIED INPUT DATA SELECTOR BOARD	65K	32%

19.-20. RESERVED.

CHAPTER 4. ENHANCED DARC IMPLEMENTATION

21. GENERAL. Planning charts for the enhanced DARC implementation are provided in table 4-1, 4-2; figure 4-1.

22. SITE PLANNING AND SITE PREPARATION.

a. The site activities described in this section include the site survey activities; the preparation of site planning documents; and the installation of new cabinets, power, and grounding.

b. Site surveys have been conducted by the contractor for the FAA Technical Center, the FAA Academy, and the first field site (Cleveland ARTCC). Site surveys will be accomplished by the regional offices as required for the remaining 19 sites.

c. Standard Site Preparation Report.

(1) The Standard Site Preparation Report prepared for the initial DARC installations along with the contractor supplied "Enhanced DARC Standard Site Preparation Report" shall be used for the Facilities and Equipment planning for DARC enhancements. This document covers the activities that must be completed by the FAA to prepare a particular site to receive the DARC enhancement equipment and includes the following:

(a) Definition of power requirements, circuit breaker panels and physical space requirements for each deliverable unit. The report includes starting surge current data, circuit breaker requirements and any other information needed for the Government to prepare for the equipment installation.

(b) Definition of cable and connector requirements for the complete installation.

(c) Definition of contractor's office equipment and space requirements to be furnished by the facility during the installation and checkout period. (Applicable only for FAA Technical Center, FAA Academy, Cleveland, and Boston).

(2) For Sites no. 3 through no. 22, the regions shall be responsible for reviewing the standard site preparation report concerning all activities required for the preparation of the sites for the enhanced DARC system.

d. Site Preparation.

(1) Site 1 - FAA Technical Center. ACT-600 is responsible for the engineering and installation of power and grounding to the additional two magnetic tape unit cabinets, simulator cabinet, and two input/output teletypes as per the Upgraded DARC Installation Document, FAA Technical Center.

(2) Site 2 - FAA Academy. AAC-400 is responsible for the engineering and installation of power and grounding to the additional simulator cabinet, two magnetic tape unit cabinets, and two input/output teletypes as per the Upgraded DARC Installation Document, FAA Academy.

(3) Site 3 - Cleveland. AGL-400 is responsible for the engineering and installation of power and grounding to the additional simulator cabinet, two magnetic tape unit cabinets, and two input/output teletypes as per the Upgraded DARC Installation Document, Cleveland.

(4) Site 5 - Boston. ANE-400 is responsible for engineering and installation of power and grounding to the additional simulator cabinet, two magnetic tape unit cabinets, and two input/output teletypes as per the Upgraded DARC Standard Site Preparation Report.

(5) Sites 4, 6 -22. The regional Airway Facilities division associated with each site is responsible for the engineering (including cabinet location), inventory and inspection, cabinet placement, and installation of power and grounding to the simulator cabinet, two magnetic unit cabinets, and two input/output teletypes as per the Upgraded DARC Standard Site Preparation Report.

23. THE IMPLEMENTATION PROCESS.

a. General.

(1) The implementation will be in four phases:

(a) Phase A - installation of PVD EEM modification.

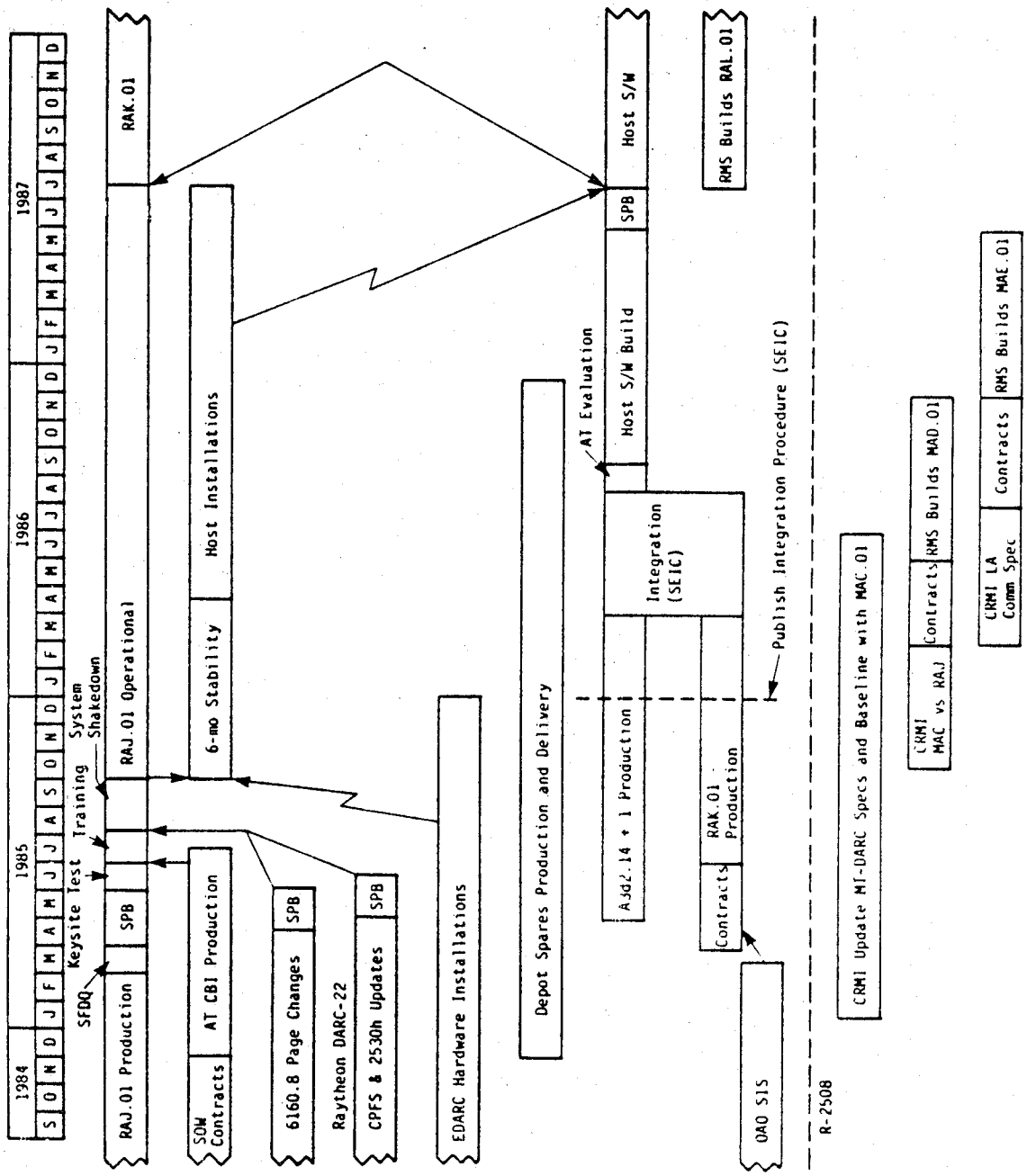
(b) Phase B - installation and checkout of the CDC/RDS and DARC hardware EEM packages.

(c) Phase C - adaptation, checkout, and baselining or the mosaicking and tracking software enhancements (DARC version RAJ).

(d) Phase D - adaptation, checkout, and baselining of the enhanced 9020/DARC interface software.

(e) Figure 4-1 illustrates the time phasing of the various portions of the implementation process.

Figure 4-1
DARC Enhancement Significant
Implementation Events



(2) It is expected that to complete these phases the following time periods are necessary: 6 man hours for each PVD modified during phase A, 600 man hours phase B, 200 man hours for phase C, 160 man hours for phase D. Upon completion of phase D, the DARC facility will have all the features identified in paragraph 18 above.

(3) The modifications will impact both the operational prime display channel and the DARC systems. While the modifications are being performed, portions of these systems will not be available for air traffic control utilization.

(4) All maintenance and diagnostic software will be delivered at the time Phase B begins.

(5) The following paragraphs will describe each phase in detail and the functional capabilities of the DARC facility upon completion of the phase. The number of modification kits is listed in table 4-1.

b. Phase A - Installation of the PVD EEM.

(1) The modification requires adding and routing two wires from the PVD's RKM connector to the PVD system status control (SSC) panel, and then modifying the panel itself, to isolate S1 and S2 from the printed circuit board.

(2) Order 6160.1, Chapter 293, Change 308, has been released by APM-160 to all sites. Installation will require approximately 6 hours per PVD.

(3) The outward result of the modification will be different labeled switches on the PVD's SSC. Pushing of S1 (prime/DARC) will result in no change in display presentation. Pushing of S2 (TV mode) will cause the broadband TV presentation to be shown on the PVD.

c. Phase B - Installation of the DGU, RKM, DP, CP, SSC, SMMC, magnetic tape, and simulator modifications. Five separate EEMs will be installed during this phase. They have been grouped together since they are interrelated and must be installed in a prescribed sequence.

(1) Installation of the DARC enhancement modification to the display generators and radar keyboard multiplexors.

(a) This modification will make the following changes to the display generator (DG), and radar keyboard multiplexer (RKM):

Table 4-1
DARC Enhancement Number of Units Kits

SITE NO.	SITE	UNIT KITS									
		SSC MOD KITS	RKMcab MOD KITS	DGcab MOD KITS	SSMC MOD KITS	PVD MOD KITS	DP MOD KITS	CP MOD KITS	SIMS MOD KITS	IOT MOD KITS	MTU MOD KITS
1	FAA TECH CTR	1	3	6	2	34	4	2	1	2	2
2	ACADEMY	1	2	3	2	23	2	2	1	2	2
3	CLE	1	3	6	1	68	12	2	1	2	2
6	SLC	1	2	5	1	36	7	2	1	2	2
8	MSP	1	2	5	1	48	9	2	1	2	2
15	CHI	1	3	7	1	67	12	2	1	2	2
4	DCA	1	3	7	1	59	11	2	1	2	2
7	NYC	1	3	7	1	63	12	2	1	2	2
11	OAK	1	2	5	1	42	8	2	1	2	2
9	ATL	1	2	6	1	65	12	2	1	2	2
19	LAX	1	2	6	1	57	11	2	1	2	2
12	IND	1	2	6	1	57	11	2	1	2	2
20	MKC	1	2	6	1	58	11	2	1	2	2
10	FTW	1	2	7	1	61	11	2	1	2	2
13	DEN	1	2	5	1	50	9	2	1	2	2
14	JAX	1	2	6	1	55	11	2	1	2	2
16	MEM	1	2	5	1	55	10	2	1	2	2
21	HOU	1	2	6	1	59	11	2	1	2	2
22	MIA	1	2	6	1	46	9	2	1	2	2
17	SEA	1	2	5	1	39	7	2	1	2	2
18	ABQ	1	2	6	1	49	10	2	1	2	2
5	BOS	1	2	6	1	48	9	2	1	2	2
OTHER				1		87					
TOTALS		22	49	132	24	1226	209	44	22	44	44

1 Removes 6 PCBs from each DGU.

2 Installs 6 new PCBs in each DGU.

3 Removes from the DG group of cabinets a cable harness presently distributing control signals from the display mode select and status panel (DMSS).

4 Installs in the DG group of cabinets several cable harnesses which will distribute individual PVD switching control signals and DARC communication signals.

5 Removes a cable harness from the RKM cabinets presently distributing DARC R-Control signals and DMSS control signals.

6 Installs in each RKM cabinet 3 new cable harnesses which will distribute DARC R-Control signals and individual switching control signals from the various PVDs.

7 Installs two PVD configuration display boards in each RKM cabinet to receive the individual switching control signals.

8 Removes two system cables presently distributing control signals from the DMSS.

9 Installs 3 system cables per RKM which will distribute individual switching control signals.

(b) Order 6160.1, Chapter 292, Change 314, was released by APM-160 to all sites. The associated modification kit will be delivered as per table 4-2. Installation of the modification will require 12 hours for each DG cabinet. The modification will be performed by Raytheon personnel at the FAA Technical Center, the FAA Academy, Cleveland ARTCC, and Boston ARTCC. FAA personnel will install the modification at all other sites.

(c) Sites at which the modification will be installed by FAA personnel shall not proceed with the modification until clearance is granted by APM-160. APM-160 will be controlling the installation to assure they will have sufficient resources for support via telephone or on site if required to restore system.

(d) The EEM has been designed for installation and checkout to be done in 4 hour increments of time or less. This will allow the site to return to normal operation until downtown is available for the next increment of modification.

(e) Once the modification is complete, the switching of the PVDs from the primary channel to DARC will no longer be controlled by the switch panel at the SMMC, but, rather by the individual controller at his PVD.

(2) Installation of the DARC enhancement modification to the system maintenance monitor console (SSMC):

Table 4-2
Detail of DARC Enhancement Material Delivery

SITE	PVD MODS DELIVERY	REMAINING MODS DELIVERY	MODIFIC. START DATE	MODIFIC. COMPLETION DATE
FAA Technical Center	Apr 1984	May 1984	May 1984	May 1984
FAA Academy	Jun 1984	Jun 1984	Jun 1984	Jul 1984
Cleveland	Apr 1984	Jul 1984	Jul 1984	Sep 1984
Washington	Jun 1984	Oct 1984	May 1985	May 1985
Boston	May 1984	Sep 1984	Sep 1984	Nov 1984
Salt Lake City	Jun 1984	Oct 1984	Jan 1985	Jan 1985
New York	Jun 1984	Oct 1984	Mar 1985	Apr 1985
Minneapolis	Jun 1984	Dec 1984	Jan 1985	Feb 1985
Atlanta	Jul 1984	Jan 1985	Mar 1985	Apr 1985
Fort Worth	Jul 1984	Feb 1985	May 1985	Jun 1985
Oakland	Jun 1984	Mar 1985	May 1985	Jun 1985
Indianapolis	Jul 1984	Mar 1985	Jul 1985	Aug 1985
Denver	Jul 1984	Mar 1985	Jul 1985	Aug 1985
Jacksonville	Aug 1984	May 1985	Jul 1985	Aug 1985
Chicago	Jun 1984	Jun 1985	Sep 1985	Oct 1985
Memphis	Aug 1984	Aug 1985	Sep 1985	Oct 1985
Seattle	Aug 1984	Jun 1985	Sep 1985	Oct 1985
Albuquerque	Aug 1984	Jul 1985	Sep 1985	Oct 1985
Los Angeles	Aug 1984	Jul 1985	Nov 1985	Dec 1985
Kansas City	Aug 1984	Jul 1985	Nov 1985	Dec 1985
Houston	Aug 1984	Jun 1985	Jul 1985	Aug 1985
Miami	Aug 1984	Aug 1985	Nov 1985	Dec 1985

(a) This modification will make the following changes in the system maintenance monitor console (SMMC):

1 The removal of the display mode select and status (DMSS) module from the SMMC.

2 The installation of the PVD configuration display (PCD) panel in the SMMC.

3 The replacement of the front panel to the DARC system status panel (SSP) presently installed in the SMMC.

(b) Order 6140.1, Chapter 26, Change 44, was released by APM-160 to all sites. The associated modification kit will be delivered as per table 4-2. Installation of the modification will require approximately 6 hours and can be broken into two 3-hour segments. The modification was performed by Raytheon personnel at the FAA Technical Center, FAA Academy, Cleveland ARTCC, and Boston ARTCC. FAA personnel will install the modification at all other sites. The modification will be accomplished as part of the DGU and RKM modifications described above.

(c) The DARC enhancement modification to the SMMC will provide the system engineer with an indicator panel which indicates the source of display data for each individual PVD. The data source is primary system or DARC system.

(d) In addition, the DARC system status panel is modified to reflect a reallocation of indicator lamps.

(3) Installation of the DARC enhancement modification in the CP, DP, and system status control.

(a) This modification will make the following changes in the control processor (CP), display processor (DP) and system status control (SSC):

1 The removal of four core memories from each CP.

2 The installation of two dynamic memory boards (DMB) in each CP.

3 The installation of a supplementary processing board (SPB) in each CP.

4 The installation of a battery backup unit (BBU) in each CP.

5 The removal of four core memories from each DP.

6 The removal of one input data selector (IDS) board from each DP.

7 The installation of two dynamic memory boards (DMB) in each DP.

8 The installation of a supplementary processing board (SPB) in each DP.

9 The installation of a modified input data selector (MIDS) board in each DP.

10 The installation of a battery backup unit (BBU) in each DP.

11 The reworking of SSC backplane wiring to provide from the new DARC/GPI interface.

12 The installation of a general purpose, input interface (GPII) board in the SSC.

13 The installation of the two control processor interface boards in the SSC to provide for the new DG communication interface and the new IOT interface (for SMMC management of the DARC system).

14 The installation of an auxiliary I/O panel in the SSC to provide the new SSC/Mag Tape interface.

15 The installation of a RMUX Switch panel in the SSC to provide for the new SIMS/RMUX interface.

(b) Order 6160.10, Chapter 20, Change 21, was released by APM-160 to all sites. The modification kit will be delivered as per table 4-2. The installation of the modification will require 18 hours for the SSC cabinet, 4 hours per CP cabinet, and 4 hours per DP cabinet. The modification was performed by Raytheon personnel at the FAA Technical Center, FAA Academy, Cleveland ARTCC, and Boston ARTCC. FAA personnel will install the modification at all other sites.

(c) Sites at which the modification will be installed by FAA personnel shall not proceed with the modification until clearance is granted by APM-160. APM-160 will be controlling the installation to assure they will have sufficient resources to assist the sites during the installation.

(d) The EEM has been designed for installation and checkout to be done in 4 hour increments of time or less. This will allow the site to return to normal operation until downtime is available for the next increment of the modification.

(e) The DARC enhancement modification will provide the DARC system with four additional interfaces: 9020 system, mag tape system, display generator system and DARC input simulator. In addition it greatly enhances the processing capability of each CP and DP while doubling available memory.

(4) Installation of the DARC tape drives.

(a) This modification will provide for the installation of the cabinets and their required interfacing with the system status control (SSC) cabinet. This modification shall be done following the modification of the SSC as described above in paragraph 23c(3).

(b) Order 6160.10, Chapter 18, Change 19, was released by APM-160 to all sites. The associated modification (cabinets, cables, drives) will be delivered as per table 4-2. Installation of the tape drives and associated cabinets and interface cabling will require approximately six hours per tape drive.

(c) As a result of this modification, the DARC system shall be able to record significant data concerning targets, controller input, system status, and internal processing.

(5) Installation of the DARC simulator subsystem.

(a) This modification will provide for the installation of the simulator subsystem (SIMS) and its required interfacing with the SSC. This modification shall be done following the modification of the SSC as described above in paragraph 23c(3).

(b) Order 6160.10, Chapter 19, Change 20, was released by APM-160 to all sites. The associated modification kit (SIMS cabinet, interconnecting cables) will be delivered as per table 4-2. Installation of the SIMS cabinet, interfacing of the SIMS to the SSC, and the checkout of SIMS will require approximately six hours total.

(c) As a result of this modification, the DARC system will have the capability of simulating RMUX, R-Controls, GPO/GPI, or Data Receiver Group (DRG) input. These simulated inputs will be used during the baselining of DARC software, serving as known loads from which a given set of DARC performance factors can be measured.

d. Phase C - Implementation of the mosaicking tracking software.

(1) Completion of Phase B of the installation process will result in the DARC system having the enhanced hardware installed which will operate essentially the same as before except for the added individual PVD switching capability.

(2) Phase C is the adaptation and baseline testing of software version RAJ which will be released by APM-160 in a manner consistent with prior DARC software deliveries. RAJ will consist of the software developed by Raytheon for the DARC enhancement modification. It will contain all the features described in paragraph 23 above, but will not be able to exercise the enhanced 9020 interface functions, since the 9020 software, at the time RAJ is delivered to sites no. 3 - no. 22, will not contain the required accompanying interface software.

(3) The RAJ software has undergone extensive submodule, module, subprogram, and system level tests at the contractor's facility, at the FAA Technical Center, and at the Cleveland ARTCC. Program trouble reports (PTRs) resulting from these contractor tests and independent government tests will have been resolved before the APM-160 delivery of RAJ to the field.

(4) It is expected that the adaptation and baseline testing of phase C will require 30 days at each DARC site. Reporting of progress and/or problems will be done as per normal procedures associated with the release of a new version of DARC software. New support software will allow use of 9020 ACES object tapes and 9020 Geo-map tapes for building the new RAJ adaptation.

e. Phase D - Implementation of the enhanced 9020/DARC interface.

(1) This phase involves the national release of a 9020 software version which will contain the necessary modifications to fully enable the 9020/DARC bidirectional interface, as specified by NAS-MD-741, "DARC ICD: Central Computer Complex (CCC)/DARC Control Processor (CP)". Additionally, there will be a national release of DARC software version RAK which will be compatible with the new 9020 software version.

(2) APM-210 is responsible for providing the Air Traffic Plans and Requirements Service with the necessary 9020 modifications to enable this interface. The software modifications will be developed under a separate contract. A contract was awarded in March 1984. APM-160 is responsible for developing the RAK version of the DARC software. Development shall begin by May 1985.

(3) Once the new 9020 software version and the DARC RAK version have been released to the field, each site will conduct baseline testing on both the 9020 software and on the DARC software. This will be the first time the enhanced 9020/DARC features of the DARC software will be exercised at the site. It is expected that adaptation parameters in both the DARC and 9020 software will have to be modified to obtain the optimum 9020/DARC interface which will have the least load upon the 9020 system.

(4) It is expected that to accomplish the 9020/DARC integration task, each site will require 20 days in addition to the normal time required for 9020 software baseline testing. Reporting of progress and/or problems will be done as per the normal procedures associated with the release of a new software version. Problems associated with the hardware portion and DARC software portion of the enhanced interface will be reported to APM-160. Problems associated solely with the 9020 software version will be reported to ATR-560. If a determination cannot be made as to the cause of a problem, the problem should be reported by the site to both APM-160 and ATR-560.

24. CONTRACTOR PREPARATION AND CHECKOUT OF THE DARC HARDWARE ENHANCEMENT EEM's.

a. Raytheon has developed EEM's necessary to install the DARC enhancement hardware. The EEM's were installed by Raytheon at its factory test bed, at the FAA Technical Center, at the FAA Academy, at Cleveland ARTCC, and Boston ARTCC. Problems found in the installation procedures were resolved, and the EEM's have been updated with these solutions.

b. The factory portion of the total test program was segmented into the following groups:

(1) CP and DP enhancement kits.

(2) DG I/O kits.

(3) RKM kits.

(4) Simulator cabinets.

(5) Tape drive cabinets.

c. The following paragraphs describe this factory acceptance testing:

(1) CP and DP kits. The factory acceptance tests for the CP and DP enhancement kits are conducted on an enhance DARC system mini-system consisting of 2 CP cabinets, an SSC cabinet and 4 dual cabinets. The kit hardware is installed in the mini-system and M & D diagnostic tests are performed on each portion of the system.

(2) DG I/O kits. The DG I/O kits are tested in a DG I/O basket test station. The test station, driven by a DG diagnostic test program will provide a simulated system environment to exercise all DG I/O interfaces. The test station will also simulate I/O error conditions to verify the functional responses of all error conditions related to faulty inputs.

(3) RKM Kit PCBs. The RKM kit circuit board assembles (PCBs) are verified on the enhanced DARC system PCBT or a similar circuit board test device. The associated cable assembles are verified via continuity tests during the manufacturing process.

(4) Tape Drive Cabinets. The tape drive cabinets are tested in the enhanced DARC mini-system. An M & D diagnostic routine is used to verify performance.

(5) Simulator Cabinets. The simulator cabinets, which include an off-the-shelf RDS-500 CPU and simulator modules, are verified as follows:

(a) The RDS-500 CPUs are tested by the subcontractor (RDS) at his facility and acceptance test data supplied.

(b) The simulator modules are verified on the enhanced DARC system PCBT tester using a diagnostic routine or on an equivalent manufacturing tester used in the manufacturing process.

25. RESERVED.

CHAPTER 5. INTEGRATED LOGISTICAL SUPPORT FOR THE DARC ENHANCEMENT

26. DOCUMENTATION. In addition to changes to existing documentation, the following publications will be added:

NAS-MD-1310--Introduction to Specification Series
NAS-MD-1311--Message Entry and Checking
NAS-MD-1314--Local Outputs
NAS-MD-1320--Multiple Radar Data Processing
NAS-MD-1321--Automatic Tracking
NAS-MD-1322--Real Time Quality Control of Radar
NAS-MD-1326--Adaptation Collection Guidelines

27. OPERATIONAL REQUIREMENTS. The operational requirements for the enhanced DARC system will be the same as for the basic DARC system. DARC will perform as backup to the primary channel.

28. PLANNING STANDARDS. The following FAA directives shall be used as standards and guidelines for DAR enhancement program:

a.	1100.1A	FAA Organization - Policy and Standards.
b.	1100.134A	Maintenance of National Airspace System Automation Subsystem.
c.	1320.37A	Contractor-Developed Equipment Instruction Books.
d.	1380.40A	Airway Facilities Sector Level Staffing Standards System.
e.	1800.8D	NAS Configuration Management.
f.	1800.30	Development of Logistic Support for FAA Facilities and Equipment.
g.	4250.9A	Field Inventory Management and Replenishment Handbook.
h.	4560.1A	Initial Provisioning for Support of Facilities, Facility Components, Aircraft and Avionic Equipment.
i.	4620.3C	Initial Support for New of Modified Equipment.
k.	4800.2A	Utilization and Disposal of Excess and Surplus Personal Property.
l.	6000.18	Field Repair of Equipment.
m.	6020.2A	Joint Acceptance Inspection for FAA Facilities.
n.	6200.4B	Test Equipment Management Handbook.
o.	FAA-G-1210	Provisioning Technical Documentation.
p.	FAA-G-1375	Spare Parts - Peculiar for Electronic, Electrical and Mechanical Equipment.
q.	FAA-E-2552	Technical Training Specification.
r.	FAA-E-2530	Direct Access Radar Channel (DARC).

29. MAINTENANCE CONCEPT. The DARC maintenance concept will not change with the implementation of the enhancement features. DARC maintenance procedures and documentation will be revised to apply to the DARC enhanced equipment. Reliability and maintainability requirements are listed in paragraphs 29a and 29b.

a. Reliability.

(1)	MTBF of System, including Peripheral equipment	1250 hours
(2)	MTBF of Disk Units (or Magnetic Tape Units)	4000 hours
(3)	MTBF of Card readers	2000 hours
(4)	MTBF of Line Printers	2000 hours

b. Maintainability.

(1)	System MTTR	0.5 hours
(2)	System Maximum Repair Time	1 man hour
(3)	Mean Bench Repair Time	4 man hours
(4)	Maximum Bench Repair Time	8 man hours
(5)	Maximum Time for Corrective and Preventive Maintenance	2 mhr/per day

c. Maintenance Planning.

(1) APM-160 will revise Order 6100.1 to incorporate performance and certification standards for the enhanced DARC features and will coordinate with other agency groups to revise qualification and classification standards for field maintenance personnel.

(2) Long-range maintenance spare parts levels, field training, and documentation has been revised for the enhanced DARC features. This revision place with the help of the regions and other services.

(3) Planning for additional site support, in terms of contractor personnel,spares, additional test or operational equipment, and documentation shall be determined by APM-210 and other service personnel.

(4) DARC maintenance procedures and diagnostics, revised to apply to the enhanced DARC features, were demonstrated during factory testing.

30. TRAINING. This section discusses the training required to maintain the enhanced DARC system.

a. Responsibilities.

(1) Airways Facilities Program Division (APM-100). This division has established Airway Facilities (AF) training requirements, reviewed training plans developed by the FAA Academy, and assured timely accomplishment of training.

(2) Office of Personnel and Technical Training (APT-300). This office assisted in the development of training proposals, review and approval of training plans, the selection of training methodology required, and the procurement and quality control of training deliverables.

(3) FAA Academy (AAC-940). Developed, enhanced DARC update courses and revised existing DARC courses from contractor-supplied documentation.

(4) ARTCC Facilities. Schedule on-the-job training (OJT) and hands-on training (HOT) as dictated by operational requirements.

b. FAA Academy Training.

(1) Enhanced DARC upgrade training was provided by the FAA Academy to personnel who have maintenance responsibilities for the enhanced DARC system and had completed resident training on the DARC system.

(2) In addition, the former DARC courses (43473, 43479, and 43480) have been revised to include enhanced DARC training.

c. Computer Based Instruction (CBI) Training.

(1) The FAA Academy has developed a "C" language programming course. "C" language is the programming language in which much of the supplementary processor board, modified input data selector, and magnetic tape controller software is written. This "C" language course (#47400) is a prerequisite to the enhanced DARC software course.

(2) APM-210 in connection with APT-300 has contracted for a CBI course that demonstrates the features of enhanced DARC software. The course will be used as one part of the facility air traffic controller training of enhanced DARC.

d. Training Schedules. All upgrade training has been completed by the FAA Academy. Schedule for the revised DARC hardware, DARC software, and DARC system courses is at figure 5-1.

31. LOGISTICS.

a. Logistics Support. Support is required for all levels of maintenance for the system's programmed life cycle. The elements required for support are categorized as:

(1) Planned maintenance.

(2) Personnel and training.

(3) Logistic information and data.

(4) Spares and repair parts.

Figure 5-1
FAA Academy
DARC Enhancements Class Schedule

	1985											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
47400 - C Language (CBI)	* Continuously Available *											
43513 - Hardware Update	* 13 classes taught - no longer available											
43514 - Software Update	* 5 classes taught - no longer available											
43519 - DARC Hardware (9 week, includes enhanc)					X		X		X		X	
43520 - DARC Software (16 week, includes enhanc)							X					X
43479 - DARC System (1 week, includes enhanc)								X-X				
43426 - Display System (10 week, includes enchan)				X		X						

(5) Tools and test equipment.

(6) Facilities.

(7) Transportation and handling.

b. Engineering Support Services.

(1) APM-160 at the FAA Technical Center is responsible for site support concerning hardware and software problems and improvements. Hardware discrepancy reports (HDRs) will be prepared by site personnel and submitted to APM-160 in accordance with FAA Order 1100.134A to report hardware problems. For software problems, program technical reports (PTRs) will be completed by the DARC site personnel and forwarded to APM-160 for operational, support, and diagnostic software in compliance with paragraph 12 of FAA Order 1100.134A.

(2) Any changes resulting from these actions must be approved via the configuration management process. Changes required prior to 4th system installation shall be done by the contractor. In particular, approved hardware changes shall be installed by the contractor in accordance with electronic equipment modifications prepared by the contractor as required by FAA Order 1320.33B.

c. Logistical Support During Hardware Installation.

(1) Problems with delivered cables are to be reported to APM-160 (FTS 482-6236) for resolution.

(2) Failures of printed circuit boards are to be reported to the En Route Automation Program, APM-210, FTS 426-9360 in order that the failed board can be returned to Raytheon for repair and a replacement can be obtained.

d. Logistical Support Following Hardware Installation.

(1) Failed printed circuit boards are to be repaired by the FAA ARTCC Airways Facilities personnel using the DARC maintenance and diagnostic software, printed circuit board tester and associated software, printed circuit board documentation, and board repair equipment of the ARTCC.

(2) Repair parts are to be ordered from the FAA depot. All of the component parts for the enhanced DARC hardware has been cataloged by the FAA Depot and is available for order.

(3) An initial site stockage of common integrated circuits is available for order from the FAA depot. The enhanced DARC Initial Site Spares Allocation (ISSACs) order number is 1757.

(4) Any problems in the repair of the enhanced DARC printed circuit boards, power supplies, and other equipments is to be reported to APM-160 (FTS 482-6236) for resolution.